Canadian Section.

Meeting held at Montreal on Friday, 16th October, 1914.

PROF. J. W. BAIN IN THE CHAIR.

DEVELOPMENT OF CHEMICAL INDUSTRY IN CANADA.

BY T. H. WARDLEWORTH.

The Canadian Section of the Society of Chemical Industry at its opening meeting for the season 1914—15 finds the interests it represents in a position not likely to recur for many a long decade. Supplies of very necessary materials can no longer be secured from their usual sources, and we are compelled not only to look elsewhere for the goods, but to take steps that such a contingency does not arise again, by seeing to what extent we can provide such products in our own country, which is so rich in natural resources.

It would appear, therefore, that our Society is fulfilling its functions in a most pronounced way, when it takes upon itself the task of ascertaining to what extent the chemical industries of the country can best be helped, and as far as possible extended, to meet the needs of the present and the greater demands of the future. We may have to ask our Government to assist us in this work, and we believe we shall have a sympathetic hearing when we present our claims.

No nation has been able to compete against the scientifically managed manufactures of Germany, many of the most important of which were originally instituted in England, France, or the United States. No other country can boast of a single business combination, comprising three firms (the chemical factories of Elberfeld, Ludwigshafen, and Treptow), which employs over seven hundred qualified chemists. And yet, in spite of the unique facilities already afforded by Germany for the prosecution of pure science, further aid has been demanded and granted. The German government has for many years endowed the universities and technical schools—which indeed are under the direct control of the State—with annual sums vastly greater than those applied to similar purposes in England. In addition to this indirect method of furthering the progress of science, a Society for the Promotion of Science has recently been constituted.

The society in question is the Kaiser-Wilhelm Society, which defines in its first statute its primary object: "To promote the sciences, especially by the foundation and support of scientific institutes of research." The income of the society, subscribed by private individuals or by firms, will be devoted to the establishment of institutes of research in which distinguished investigators in the various branches of science will be afforded facilities and means for the prosecution of their chosen problems.

In prosperous times, the Canadian manufacturer thinks that he has no need of scientific assistance; in times of bad trade he believes that he cannot afford it.

As a country Canada is blessed with manifold natural advantages—our mines give us arsenic, antimony, cobalt, nickel, copper, platinum, osmiridium, gold, phosphates, magnesite, silver, chromium, tungsten, molybdenum, barytes, mica, graphite, asbestos, lime, salt, shale, and coal. There is no reason why many of the metals should not be refined in Canada. Why should all our crude nickel go abroad to be purified? Why should we not make our own copper sulphate—hundreds of tons of which are imported every year? Phosphatic rock with all its possibilities is to be found in large quantities within a hundred miles of Montreal. Tons of magnesium carbonate and calcined magnesia are imported every year: yet we have large supplies of the crude material within easy reach of Montreal. There is a very large deposit of fine grade magnesia near Ottawa which is suitable for many purposes, but would be peculiarly adapted for fire-brick were it not for the fact that it lacks a small percentage of iron, a trace practically, and this want constitutes the difference between an excellent fire-brick magnesia and one which is of no value at all. One method suggested is simply to add the iron, but it is stated that large sums of money have been spent in this direction without success. It is a problem for the younger chemists, who will turn our wonderful deposits of magnesite into a commercial proposition of exceeding value if they can only find the missing link. There is an ever-increasing demand for barium peroxide, and while there are large supplies of barytes in Nova Scotia we do not produce an ounce of the peroxide, bringing it all from England and Germany. Graphite is to be found here, and as the price of pencils is likely to be advanced, would it not be worth while to pay attention to the compounding of graphite for making pencils? If we are successful we may be sure our wood workers would do the rest. Why should our phosphorus go abroad and come back in the form of phosphoric acid, the various phosphates, phosphides, and hypophosphites, at enormously enhanced prices? In Nova Scotia, it is said there are enormous deposits of shale, now the subject of financial development. Instead of shipping the shale, why should we not make the finished products? It is true that we are doing something practical with our salt deposits, but it seems to me that our enormous imports of bleach ought to suggest a great extension of this work.

Turning to wood products, we now make wood alcohol, acetone, acetic acid, acetates of lime and soda, and formaldehyde. Why cannot we make also glacial acetic acid? We produce the 80% acid, but import the 99%.

In some directions we are doing well—the calcium carbide industry is well established, and we are beginning to supply the world, thanks to our supplies of raw materials, our magnificent water powers, and the initiative and energy of the manufacturers. The same company is about to produce ferro-silicon, and it will be on the market at an early date. We may expect cyanamide and probably other products from atmospheric nitrogen in the near future.

We also produce, and produce well, commercial sulphuric, hydrochloric, and nitric acids, but we do not make as much use of this fact as we might in other branches of chemical industry by the production of resulting compounds.

Glycerin we now refine in two centres, Montreal and Toronto, and excellent results are given by both factories.

Ethyl alcohol is also produced in this country —a fact appreciated by many of our members— but it seems to me that it is our duty to ask the Government for the privilege of free alcohol for technical purposes. It is said that the refusal of the British Government to give permission for the use of free alcohol to the infant aniline industry was the main cause of its decline and transfer to Germany. I have been informed that the Government is in many respects favourable to duty-free alcohol for chemical manufactures, but those who apply to the Government will have to be very explicit in their reasons for wanting duty-free alcohol. Would it not be possible, while dealing with this question, to know more of the development of ethyl alcohol from sawdust? Under the head of alcohol, would it not be within reason to ask the Government to make arrangements whereby manufacturers in this country could use the fusel oil, most of which is now sent to the States and comes back to us as "banana oil," so largely used by the bronze paint people, and also as amyl acetate?

We are as a country very short of potash as a product. In the past we used to produce a large quantity of potassium carbonate, but this seems to have fallen off considerably of late years, due probably to the fact that so much of the country has been cleared that there is not now the same opportunity of collecting the ashes as in the old days. At the same time we have recently heard of a process for getting potash from sawdust, but as the yield is only about 3%, it is to be feared that the process would not be profitable. The utilisation of sawdust as a basis for the manufacture of either potash or oxalic acid might be seriously considered, as we have abundant supplies of raw material, which at the present time constitutes nothing but an annoying problem to the producers. Another source of potash available to us at the present time is felspar. We believe there are large deposits of felspar in the neighbourhood of Kingston, containing about 18% of potash, and the problem is to extract this on a satisfactory basis. I have recently come in contact with another process which appears to be successful. Although dealing with a very much higher class of material which comes from somewhere down the St. Lawrence, still in my opinion it shows that the problem may be solved. There is also the prospect of potash deposits being found in British Columbia.

Carbolic acid is being produced in different parts of the Dominion, but so far as we can learn there is no evidence of the production of the finer grades, or of efforts to produce absolute phenol, and it would appear that this is a field which might be cultivated with advantage, because we have very large supplies of raw material and the demand for carbolic acid in the Dominion is very considerable. The making of the finer grades of phenol is a delicate operation, but we hope that in the near future we shall have offered to us crystallized carbolic acid of good quality of Canadian manufacture.

The paper industry seems to be well covered by the chemists, but I think the manufacturers could devote some attention to parchment paper in all its forms. We import enormous quantities of this article from Europe. As we have the primary materials here in such abundance, it should be possible for us to produce on the spot parchment paper equal to any in the world.

Ammonia is produced in large quantities and of excellent quality in the Dominion, but, so far, we do not seem to have succeeded in making the carbonate to compete with either the American or the English, and this is a point which I think might be taken up with advantage by our Canadian chemists, as we import large quantities of this particular article.

Allied to the production of ammonia is the naphthalene industry, and so far we have been able to produce a grade of flake naphthalene which compares favourably with the English and American products, but it is open to some objections which affect its sale to the general public, in any large measure. But the manufacturers hope at an early date to produce not only flake but ball naphthalene as well, of an improved quality.

I have outlined some of the lines on which the energies of our chemists may be directed for the development of the chemical industry in Canada, and I feel sure that we are capable in Canada of very largely extending the area of our usefulness in the domain of chemistry. We must look to the Government and our richer citizens for assistance to foster research, as I am convinced that a great deal of the value of the future work will depend largely upon research carried on to-day by our master-thinkers in Canada. We should depend not too much upon the illusive prospects held out by the abrogation of patents or anything of that kind, but rather should we look to our younger chemists to throw themselves into the fields of earnest work for the improvement of old processes and development of new ones.

I feel confident that, as we are the followers of men who have made the forests of Canada ring with their axe and have not been dismayed by the obstacles opposed to them, we shall have the opportunity and the will to exercise our talents and our energy for the building up of a greater, a richer, and a constantly progressive chemical industry worthy of the growing Dominion of Canada.

Discussion.

Mr. Herbert J. S. Dennison wrote as follows:—

The chemical industry is one which will probably be more closely affected than any other by the present war, as Germany in particular is noted for its activity in the chemical sciences and there are probably many patents on valuable chemical products and processes which may come within the scope of some of your members. The value of patent rights as an incentive to persons or firms developing the various arts is not generally realised, but the British Government passed an Act shortly after the declaration of War whereby the British Board of Trade was empowered to order the avoidance or suspension in whole or in part of any patent, design, or trade mark or of any license under such held by a subject of any state at war with His Majesty.

The Canadian Government followed suit, but the Canada War Measures Act of 1914 only relates to patents. These Acts have been very much misquoted and misunderstood in that these patents are not thrown open to the public generally, but the Commissioner of Patents is empowered to order the avoidance or suspension of any patent or license thereunder owned by a subject of a state at war with His Majesty, and he may grant a license to anyone applying therefor upon such terms and conditions as he may think fit, but he may require the applicant to show a *bona fide* intent to manufacture or operate under the patent and that the granting of such license will be in the general interests of the country or of a section of the community or of the trade. It is also provided that if a person, during the period of such avoidance or suspension should have made application for and obtained a license, begins to manufacture, use or sell the patented invention or to operate under a patented process, such person may continue to so manufacture or operate the invention without interference and without having to account to the original owners of the patents.

It is within the power of the Commissioner of Patents to grant one or more licenses, but he may at his absolute discretion revoke the order of avoidance or suspension and further refuse later applicants on the ground that the public is already being served by license already granted. In this manner manufacturers desiring to utilise a special process, which will require a considerable outlay of money or experiment, may be assured an exclusive license, or at least limitations in the granting to others.

In regard to foreign patents, Canadians owning patents in any of the belligerent or neutral countries may rest assured that these will be maintained in full force and effect, even in Germany or Austria, as the British Government has issued a license under which members of the Chartered Institute of Patent Agents in London may pay any fees necessary for obtaining the grant or for obtaining the renewal of patents or the registration of designs or trade marks or renewal of such registration in an enemy country. Existing patents may thus be kept in full force and effect or new applications filed which under the various international laws must be filed within certain clearly defined periods following the filing in the home countries.

Mr. Mills said that the reason why Canada did not produce chemicals was largely due to lack of knowledge. Canadian markets for chemicals were not so large as those of other countries, and consequently Canada could not produce on the same scale as Germany. On the other hand many chemicals were very high in price because they were brought from long distances. Therefore, while the demand in Canada was not big enough to start many industries, yet it should eventually be profitable to develop some lines on a small scale. It would not be wise to attempt industries which necessitated raw materials not easily obtained in Canada, for instance the dye industry, but a number of small things could be manufactured in Canada, and should be attempted at once. The raw materials produced in Canada were the basic ones, and this was unfortunate in one sense, because it meant that the quantities handled had to be fairly large; against that must be put the advantage of having the raw material on the spot. Silver nitrate had already been made in Canada, and there were many other things of a like nature. Canada had imported many things from Germany merely because they were easily obtained and not because they could not be made in Canada.

Mr. Thoms said that oxalic acid should have been made from sawdust in Canada long ago. No country had more sawdust than Canada, and caustic soda was also plentiful. The great bulk of the oxalic acid used in Canada came from Germany and was made synthetically. Before the war the price had been $6.00 per cwt., but almost immediately it had risen to $23.00.

Very little silver nitrate was imported because Canada was one of the largest producers of silver in the world, and the nitrate was very easily made. Regarding the alcohol question, the duty the Government had demanded was $1.90 per proof gallon, and $2.40 including war tax. Manufacturers of ether and chloroform in the U.S.A., where they had duty-free alcohol, had a cheap alcohol of sufficient purity to allow them to make ether and chloroform and sell it in Canada at a price lower than the cost of the necessary alcohol alone.

Mr. Goodwin suggested that the sawdust might be used in making dolls, which had to be painted; paraffin wax was used to make the faces. There were in Canada unusual possibilities in the supply of the rare elements, such as molybdenum. Was there any reason why they should not manufacture the iron alloys and other products based, for example, on molybdenite, sufficient for their own needs, and probably a large quantity for the United States? The attempt to manufacture potash from felspar at Kingston had not been very promising up to the present; but under conditions such as now existed it would bring some of the processes within reach of a margin of profit. Whether conditions would continue for long enough to give them a good start was the problem. They had been trying at Kingston, with good prospects of success, to make the potash contents of felspar available for agricultural purposes without extracting it from the felspar. Government assistance in efforts to extend manufactures might be dangerous in some ways. For instance, the German Government, in order to stimulate beet sugar manufacture in Germany, had given considerable rebate upon all sugar exported. Large manufacturers had sold their sugar in foreign markets at a lower rate than in home markets. Germany also exported great quantities of fruit which Great Britain had made into jams and exported back, and undersold the Germans in their own markets.

Mr. Millar said that they could not hope to make copper sulphate, the larger part of which came from the copper refineries in the United States. It was a by-product of the tank liquor, and could be bought for barely the price of the copper it contained. Hydroquinone could be produced fairly cheaply. It had risen from $1.00 a pound to $4-5.00 a pound. The trouble seemed to be that the gas companies did not make the same use of their tar products as was done in Germany.

Mr. G. W Chadsey said that it was a tremendous problem to undertake the manufacture of any materials which had involved a great deal of research. They could not expect to go into the market against the Germans without some of their experience. One way was to start on easy things and work up.

Mr. B. L. Emslie said that patents in regard to felspar as a source of potash had been numerous, but none of them had been really successful. The first one granted was in about 1860. The U.S. Government had appropriated a sum annually to be expended in the exploitation of the actual solution of the potash, so far with very little success. One source of potash was the kelp on the Pacific Coast, but the amount was small and in any case could not compete with the German product. A process had lately been introduced at Kingston as a result of which it was said that a 50% article would be sold at $50.00 a ton. It was questionable if it would be profitable to erect an expensive plant, because as soon as the war was over the German product would come in again and it would be impossible to compete with it. Wood ashes had been quoted as a possible solution, and were extensively used. These might be got from sawdust, which contained potash up to 3% of the ashes. Good hardwood had reached 5%, sometimes more, but the average was certainly lower. Just before the war a deposit had been reported near Sussex, N.B., but a sample of drillings had shown only a slight trace of potash in it. Recently it had been stated that further operations had revealed carnallite. On investigation they had found that there had been no further operations, but a German Potash Company believed that those deposits had been formed much in the same way as the German deposits: tidal waves had come in from the Bay of Fundy and evaporated in a dry climate. Alunite used as a fertiliser in a mixture with carnotite had been very successful, and had given results fully equal to German salts.

Mr. Southworth said that the cobalt business had been a very close secret for many years. A process leading to cobalt oxide had been worked out at Queen's College and put in operation at their own plant and the Coniagas reduction works at Thorold. There were many complications. The ore contained among other metals, cobalt, nickel, silver, and arsenic. A good many of the chemicals they were now using were manufactured in Canada, but cyanide was not. They were manufacturing a number of products, particularly cobalt oxide and cobalt metal, and nickel oxide and nickel metal.

Mr. E. H. Woodworth said that the Canadian Kodak Company was now putting metol on the market, calling it "Elon," and were supplying part of their own requirements. That had lowered the price in Canada and the United States very materially. Hydroquinone was being manufactured in the States and could now be obtained in any quantity. The cellulose acetate film was still being used, but was likely to be discarded in favour of another non-inflammable film. Eight tons of silver nitrate were used in Canada each year.

Mr. A. **Nieghorn** said that if a manufacture was carried on in Canada under German Patents when the terms of peace were arranged, the original manufacturer holding a patent would undoubtedly be allowed again to enter into competition with the manufacturer in a British Colony who had obtained a partial patent. That was only fair. That could be overcome by prohibiting the importation of the article or by protection. It was peculiar that in Canada the imports totalled nearly three hundred million dollars worth more than exports. The duty on chemicals, dyes, and medicines averaged under 6% of our total imports, while the general tariff for the two last fiscal years was something over 16½%. There seemed, therefore, room for some protection to be given to their young chemical industries. There were physical difficulties in the way of manufacturing some things. For instance, molybdenite was mined in Canada and dredged at tide-water in Florida. The Government could not protect them sufficiently to overcome that. There was room for the manufacture of several chemicals in a small way, but some assistance in the way of protection by the Government might be necessary.

Mr. Jas. **Turner** said that the reasons why England had not been prominent in the dye industry were due to non-support of the Government and of the capitalist. There was unlimited capital to be had for the dye industry to-day, and the Government had taken the matter up. In future England would be one of the largest producers of aniline dyestuffs and pharmaceutical products in the world. They had made α- and β-naphthol, H and G acids, and such things, but had not manufactured a great variety because the Germans had dumped their large surplus into England the same as sugar. Furthermore, in such things as nitrite of soda they could not compete, as the Germans made it by the lead process, and the English process was by sulphur. The litharge and other German by-products had made it impossible to compete. The plant where they were making β-naphthol, α-naphthol, H and G acids, and Clève acid ought in 6—12 months to be able to supply enough dyestuffs for England and the Colonies, but there were some products which could not be made on account of complicated patents. The duty on ethyl alcohol and methyl alcohol had been a hindrance to the colour industry for a long time, but when free alcohol had been obtainable they had put down one of the largest plants in the world for making dimethylaniline, Methyl Violet, Malachite Greens, etc. They could produce as much basic colours as any German manufacturer. If such a plant were started in Canada it would mean not only a plant for manufacturing dyes, but allied manufactures, such as a distillation plant for coal tar. The processes were elaborate and the consumption in Canada would not warrant any manufacturer putting down such a plant. But some things could be manufactured with profit: benzol and nitrobenzol for instance.

Mr. R. W. **Breadner** said that so far as he was aware, no bonuses were being granted in Germany on sugar, nor did the granting of bonuses ruin British refineries. In Canada raw sugar was not entitled to entry under the preferential tariff at the British preferential rate unless produced on British territory, and imported direct; and refined sugar was not entitled to the preferential rate unless it was made from raw sugar produced on British territory.

Mr. T. H. **Wardleworth** said that the history of the sugar question only went back about 100 years, as regards bounties. These had been instituted by Napoleon, and as a result the beet sugar manufacture was developed, bounties having been given until some ten years ago by Germany, Belgium, Russia, and France under convention. A few years ago that convention had broken up, and there was no bounty system to-day. Whatever the result of that may have been to the making of jams in England, to-day England commanded the markets of the entire world in confectionery, chocolate, and boiled sugars. From the refuse of the sugar beet was produced one of the finest carbonates of potash, 99·9%, and far more suitable than any other when a pure article was required; it might be made in Canada shortly. Canadian producers of silver could not produce metal good enough to make really good nitrate without a good deal of trouble. Some refineries left in it a trace of copper which necessitated re-working again and again. They also left bismuth and traces of other metals. What was wanted in Canada was to develop existing industries and resources, and it was better to ask not for protection in the way of duty so much as help from the Government in industrial research work. The Government should work through colleges and institutions. There seemed to be a want of co-ordination between the Government and educational institutions, and a want of co-ordination between the technical chemist and the manufacturer.

London Section.

Meeting held at Burlington House, on Monday, December 7th, 1914.

PROF. W. R. HODGKINSON IN THE CHAIR.

ON THE REDUCTION OF THE OXIDES OF ANTIMONY AND BISMUTH BY THEIR SULPHIDES.

BY W. R. SCHOELLER, PH.D.

Self-reduction, or the liberation of a metal by interaction of its oxide and sulphide with simultaneous evolution of sulphur dioxide, has been applied extensively in the metallurgy of lead and copper. All the available information concerning the behaviour of other metals under the same conditions appears to be confined to iron and antimony. Ferric oxide reacts with ferrous sulphide and produces ferroso-ferric oxide (this J., 1913, 1111); and since the two former are products of the action of heat and air on pyrites, their interaction provides a simple explanation of the presence of magnetic oxide of iron in copper mattes and roasted pyritic ores (this J., 1913, 738). Antimonious oxide and sulphide are invariably stated to fuse together without decomposition, forming "antimony-glass"; on the other hand, according to an isolated statement* which I have been unable to trace to its original source, a process based on the reaction between antimony tetroxide and sulphide is used "in some places" for the production of metal; while Schnabel† states that the

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* Bloxam, Chemistry, Inorganic and Organic. 10th Edition, 476

† Schnabel-Louis, Handbook of Metallurgy, Vol. II., 433.